UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/645,694	08/20/2003	Robin J. Green	SONYP025	9282

25920 7590 09/06/2006

MARTINE PENILLA & GENCARELLA, LLP
710 LAKEWAY DRIVE
SUITE 200
SUNNYVALE, CA 94085

EXAMINER	
REPKO, JASON MICHAEL	

ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 09/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/645,694	GREEN, ROBIN J.	
	Examiner	Art Unit	
	Jason M. Repko	2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-40* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-40* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 December 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 101

1. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 8, 9, 12-15, 16-18, and 32-35 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

2. Claims 8, 9, 12-15, and 16-18 appear to be to an abstract idea rather than a practical application of the idea. Claim 8, 9, 12-15, and 16-18 does not result in a physical transformation nor does it appear to provide a useful, concrete and tangible result. Specifically, it does not appear to produce a tangible result because merely determining lighting characteristics is nothing more than a thought or a computation within a processor. It fails to use or make available for use the result of the computations to enable its functionality and usefulness to be realized. Additionally, the asserted practical application in the specification of the computations is "rendering an image on a display screen." The practical application is not explicitly recited in the claims nor does it flow inherently therefrom.

3. Claims 32-35 are directed to a computer that solely calculates a mathematical algorithm which is non-statutory subject matter. Claims 32-35 are directed to a generic computing system performing a mathematical algorithm without making available the results of the computation. In effect, claims 32-35 seek to cover every substantial practical application of the abstract idea itself.

4. To expedite a complete examination of the instant application, the claims rejected under 35 U.S.C. 101 as non-statutory subject matter are further rejected as set forth below in

anticipation of applicant amending the claims to place them within the four categories of invention.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 1-3, 8-10, 12-21 and 26-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Peter-Pike Sloan, Jan Kautz, John Snyder, "Precomputed Radiance Transfer for Real-Time Rendering in Dynamic, Low-Frequency Lighting Environments," July 23, 2002, ACM Transactions on Graphics, v. 21, n. 3 (Sloan et al) in view of U.S. Patent Application Publication No. 2001/0028352 to Neagle et al in view of U.S. Patent Application Publication No. 2002/0126133 to Ewins.

8. With regard to **claim 1**, Sloan et al teaches "a method for rendering an object associated with an image with high resolution lighting characteristics (*Figs. 1 and 2 show rendering an object with high resolution lighting characteristics*), comprising:

a. generating a texture map associated with the image, the texture map defined by texels" (*3rd paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader."; 1st paragraph of section 6: "3. perform a linear transformation on $(L_p)_i$ at each point p on **O**..."*);

b. "calculating a value representing a lighting characteristic for each of the texels" (*2nd paragraph of section 4.1: "Because N_p is known, the SH-projection of the transfer function ($M^{DU}{}_p$) can be precomputed, resulting in a transfer vector."*); "storing the value" (*3rd paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader."*).

9. Sloan et al discloses sampling a texel (*5th paragraph of section 6.2: "The basis function textures are also supersampled and decimated in the same way as a preprocess."*), but does not disclose a sampling location within the texel. Neagle et al discloses sampling at the "center point of a pixel" *(paragraph 256: "In one embodiment, the graphics system ensures that one of the rendered samples lies in the center of the bin or pixel area.")*.

10. With regard to **claim 1**, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the sampling scheme disclosed by Neagle et al to sample the texels in the system and method disclosed by Sloan et al. The motivation for doing so would have been to sample at a location that is more representative of the given texel than any neighboring texel, an advantage well-known in the art. Therefore, it would have been obvious to combine Sloan et al with Neagle et al.

11. With regard to **claim 1**, Sloan et al teaches rendering the image using the stored value, and discloses an algorithm in the first paragraph of section 6 ("We now have a model ***O***

capturing radiance transfer at many points p over its surface, represented as vectors or matrices. Rendering ***O*** requires the following steps at run-time...") Sloan et al is silent on and rendering on a display screen. Official Notice is taken that the concept and the advantage of displaying an image on a display screen is well known and expected in the art. It would have been obvious to have included these operations in Sloan et al this feature is known to provide visual feedback in computer graphics. Therefore, it would have been obvious to further modify the combination of Sloan et al and Neagle obtain the invention described in claim 1.

12. With regard to **claim 1**, Sloan et al discloses that the transfer vectors are computed for points over the surface of the object (*2nd paragraph of section 4: "In other words, each component of $(M_p)_i$ represents the linear influences that a lighting basis function $(L_p)_i$ has on shading at p."*), stored in texture maps (*3rd paragraph of section 6*) and used to compute exit radiance over the surface of the object (*1st paragraph of section 6: "3. perform a linear transformation on $(L_p)_i$ at each point p on **O**..."*). However, Sloan et al does not expressly disclose the texels can have a many to one or one to many correspondence with pixels, and a texture coordinate space is associated with display coordinate space. Ewins teaches "associating a coordinate space of the texture map with a display screen coordinate space" and "generating a texture map associated with an image, the texture map defined by texels" (*paragraph [0014]: "Perspective-corrected texture mapping involves an algorithm that translates "texels" (data points from the bitmap texture image) into display pixels in accordance with the spatial orientation of the surface."*), "wherein each of the texels are capable of having a one of a one to many correspondence with respective pixels or a many to one correspondence with a single pixel" (*paragraph [0017]: "This conception is useful in analyzing the mapping between a texture*

map and image space. One pixel in the image space can fall across many texels in the stored texture map, or one texel may cover many pixels.").

13. With regard to **claim 1**, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the pixel, texel, and geometry correspondence taught by Ewins to the system and method disclosed by Sloan et al and Neagle. The suggestion and motivation for doing so would have been create a perspective correct image. Therefore, it would have been obvious to further modify the combination of Sloan et al with Neagle et al with the teachings of Ewins to obtain the invention specified in **claim 1**.

14. With regard to **claim 2**, Sloan et al discloses "determining visibility from a point associated with one of the texels" (*3rd paragraph of section 5: "An initial pass simulates direct shadows from paths leaving L and reaching sample points p $\in$* ***O****."*); "and determining a distribution of an incoming light ray" (*3rd paragraph of section 5: "In subsequent passes, interreflections are added, representing paths from L that bounce a number of times off O before arriving at p (Lp, LDp, LDDp, etc.)"*). Sloan et al does not use the explicit language "associated with one of the texels"; however, one of ordinary skill in the art would recognize from the equations given in section 5, in the sixth and seventh paragraphs, that the results of the calculations are stored in the transfer vector $(M_p)_i$ and the transfer vector is stored in the texture map as shown in claim 1. As shown in the rejection of parent claim 1, Sloan et al does not disclose using the "center point." Neagle et al discloses sampling at the pixel center (*paragraph 256*). As previously shown in the rejection of parent claim 1, it would have been obvious to combine Neagle et al with Sloan et al by sampling the center of the texel to obtain the advantage as described in the rejection of parent claim 1.

15. **Claim 3** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al discloses "an occlusion function is applied to determine the visibility" (*2nd paragraph of section 4.1: "...where the additional visibility function, $V_p(s) \rightarrow \{0,1\}$, equals 1 when a ray from p in the direction s fails to intersect **O** again (i.e., is unshadowed).*"; *5th paragraph of section 5: "We tag each direction s_d with an occlusion bit, $1-V_p(s_d)$, indicating whether s_d is in the hemisphere and intersects **O** again (i.e., is self-shadowed by **O**).*"); "and ray tracing is applied to determine the distribution of incoming light" (*7th paragraph of section 5: "Later interreflection passes traverse the bins having the occlusion bit set during the shadow pass. Instead of shadow rays, they shoot rays that return transfer from exiting illumination on **O**.*").

16. With regard to **claim 8**, Sloan et al discloses "a method for incorporating lighting characteristics of an image of an object into a texture map (*section 6: "For efficiency, we precompute textures for the basis functions... The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$...*"; *2nd paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader.*"), comprising":

> c. "determining a lighting characteristic (*2nd paragraph of section 4.1: "Because N_p is known, the SH-projection of the transfer function ($M^{DU}{}_p$) can be precomputed, resulting in a transfer vector.*") associated with a texel of the texture map" (*3rd paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader.*"; *1st paragraph of section 6: "3. perform a linear transformation on $(L_p)_i$ at each point p on **O**...*");

d. "and associating the texel with the lighting characteristic" (*3^{rd} paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader."*);

17. Although Sloan et al teaches using the texture maps for storing transfer vectors, Sloan et al is silent on "defining a texture map associated with the image." However, this feature is deemed inherent, as shown in the rejection of claim 1. Sloan et al discloses sampling a texel (*5th paragraph of section 6.2: "The basis function textures are also supersampled and decimated in the same way as a preprocess."*), but does not disclose a sampling location within the texel.

18. With regard to **claim 16**, Sloan et al discloses a method for rendering an object associated with an image (*Fig. 2*), comprising: "defining a texture map associated with the image" as shown in the rejection of claim 8; determining an intensity of a pixel associated with the texel, the determining including, accessing the value associated with the texel; and applying the value to a quantity representing a light source component (*2^{nd} paragraph of section 6.2: "The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$"; Figure 2 shows an overview of this process*). Furthermore, Sloan et al teaches a method comprising the operation of "associating a value corresponding to a multi-directional signal with a texel of the texture map" (*1^{st} paragraph of section 4.1: "...N_p is the objects normal at p, and $H_{Np}(s) = \max (N_p \bullet s, 0)$ is the cosine-weighted, hemispherical kernel about N_p."; 2^{nd} paragraph of section 4.1: "Because N_p is known, the SH-projection of the transfer function ($M^{DU}{}_p$) can be precomputed, resulting in a transfer vector."; 3^{rd} paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader."*).

Sloan et al does not expressly disclose "sampling a center point of the texel."

19. With regard to **claims 8 and 16**, Neagle et al discloses sampling at the "center point of a pixel" (*paragraph 256: "In one embodiment, the graphics system ensures that one of the rendered samples lies in the center of the bin or pixel area."*).

20. With regard to **claims 8 and 16**, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the sampling scheme disclosed by Neagle et al to sample the texels in the system and method disclosed by Sloan et al. The motivation for doing so would have been to sample at a location that is more representative of the given texel than any neighboring texel, an advantage well-known in the art.

21. With regard to **claims 8 and 16**, Sloan et al discloses that the transfer vectors are computed for points over the surface of the object (*2nd paragraph of section 4: "In other words, each component of $(M_p)_i$ represents the linear influences that a lighting basis function $(L_p)_i$ has on shading at p."*), stored in texture maps (*3rd paragraph of section 6*) and used to compute exit radiance over the surface of the object (*1st paragraph of section 6: "3. perform a linear transformation on $(L_p)_i$ at each point p on* ***O****..."*). However, Sloan et al does not expressly disclose the texels can have a many to one or one to many correspondence with pixels. Ewins teaches "generating a texture map associated with an image, the texture map defined by texels" (*paragraph [0014]: "Perspective-corrected texture mapping involves an algorithm that translates "texels" (data points from the bitmap texture image) into display pixels in accordance with the spatial orientation of the surface."*), "wherein each of the texels are capable of having a one of a one to many correspondence with respective pixels or a many to one correspondence with a single pixel" (*paragraph [0017]: "This conception is useful in analyzing the mapping*

between a texture map and image space. One pixel in the image space can fall across many texels in the stored texture map, or one texel may cover many pixels.").

22. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the pixel, texel, and geometry correspondence taught by Ewin to the system and method disclosed by Sloan et al and Neagle. The suggestion and motivation for doing so would have been create a perspective correct image. Therefore, it would have been obvious to further modify the combination of Sloan et al with Neagle et al with the teachings of Ewin to obtain the invention specified in **claims 8 and 16**.

23. With regard to **claim 9,** Sloan et al further discloses a "method operation of determining a lighting characteristic associated with a texel of the texture map includes, identifying a point on the object associated with the image" (*3rd paragraph of section 5: "An initial pass simulates direct shadows from paths leaving L and reaching sample points p $\in$ O [model of an object]."*); "and calculating a coefficient representing the lighting characteristic through the application of a basis function" (*2nd paragraph of section 4: "In other words, each component of $(M_p)_i$ represents the linear influence that a lighting basis function $(L_p)_i$ has on shading at p."; 1st paragraph of section 6: "...compute incident lighting $\{L_{Pi}\}$ at one or more sample points P_i near **O** in terms of the SH basis, 2. rotate L_{Pi}..."*). Sloan et al discloses using the texel (*section 6: "For efficiency, we precompute textures for the basis functions... The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$..."*), but does not expressly disclose using the center point. Neagle et al discloses sampling at the pixel center (*paragraph 256*). As previously shown in the rejection of parent claim 8, it would have been obvious to

combine Neagle et al with Sloan et al by sampling the center of the texel to obtain the advantage as described in the rejection of parent claim 8.

24. With regard to **claim 10**, Sloan shows the limitations of claim 8 on which claim 10 depends. Sloan et al teaches "the lighting characteristic defines shadows associated with the image being displayed" (*Figure 2 : "A transfer vector at a particular point on the surface represents how the surface responds to incident light at that point, including global transport effects like self-shadowing and self-interreflection."*). In figure 1, Sloan et al shows an image rendered using precomputed radiance transfer, which uses lighting characteristics as shown in the rejection of claim 8; however, Sloan et al is silent on rendering the image on a display screen.

25. With regard to **claim 19**, Sloan et al shows the limitations of claim 16 on which claim 19 depends. Sloan et al is silent on "displaying the pixel having the intensity."

26. With regard to **claims 10, and 19**, Official Notice is taken that the concept and the advantage of "associating a coordinate space of the texture map with a display screen coordinate space, rendering the image on a display screen and displaying pixels" are well known and expected in the art. It would have been obvious to have included these operations in Sloan et al as "associating a coordinate space of the texture map with a display screen coordinate space, rendering the image on a display screen and displaying pixels" are known operations to provide visual feedback in computer graphics. Therefore, it would have been obvious to further modify the combination of Sloan et al and Neagle obtain the invention described in **claims 10 and 19**.

27. **Claim 12** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al discloses "the lighting characteristic includes both self shadowing and self interreflection components" (*Figure 2: "A transfer vector at a particular point on the surface*

represents how the surface responds to incident light at that point, including global transport effects like self-shadowing and self-interreflection. ").

28. **Claim 13** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al discloses "the method operation of determining a lighting characteristic associated with a texel of the texture map includes, calculating the lighting characteristic in a manner such that an intensity of the lighting characteristic does not fluctuate when a light source in moved" (*1st paragraph of section 4.3: " An important limitation of precomputed transfer is that material properties of **O** influencing interreflections in T_{DI} and T_{GI} (like albedo or glossiness) must be 'baked in' to the preprocessed transfer and can't be changed at run-time."*).

29. **Claim 14** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al discloses "the lighting characteristic is derived from a transfer function" (*2nd paragraph of section 4.1: "Because N_p is known, the SH-projection of the transfer function ($M^{DU}{}_p$) can be precomputed, resulting in a transfer vector."*)

30. **Claim 15** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al discloses "the transfer function calculates a value representing reflected light from a surface of an object associated with the image" (*2nd paragraph of section 4.2: "We can then define the analogous three glossy transfer function for the unshadowed, shadowed, and interreflected cases as…which output scalar radiance in direction R as a function of L_p and R, quantities both unknown at precomputation time."*).

31. With regard to **claim 17**, Sloan et al further discloses "the method operation of associating a value corresponding to a multi-directional signal with a texel of the texture map includes, computing a function representing reflected light over a sphere of incoming light

relative to the center point associated of the texel" (*5^{th} paragraph of section 5: "In the first pass, for each p $\in$ O [model object], we cast shadow rays in the hemisphere about p's normal N_p... "*). Sloan et al discloses using the texel (*section 6: "For efficiency, we precompute textures for the basis functions... The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$... "*), but does not expressly disclose using the center point. Neagle et al discloses sampling at the pixel center (*paragraph 256*). As previously shown in the rejection of parent claim 16, it would have been obvious to combine Neagle et al with Sloan et al by sampling the center of the texel to obtain the advantage as described in the rejection of parent claim 16.

32. **Claim 18** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al teaches "associating a value corresponding to a multi-directional signal with a texel of the texture map includes, inserting the value with data corresponding to the texel" (*3^{rd} paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader. "*).

33. **Claim 20** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al discloses "the method operation of applying the value to a quantity representing a light source component includes, projecting both the function representing reflected light and a function deriving the light source component into spherical harmonic coefficients" (*1^{st} paragraph of section 4.1: "By SH-projecting L_p and H_{Np} separately, equation (5) reduces T_{DU} to an inner product of their coefficient vectors. "; 3^{rd} paragraph of section 4.1: "Separately SH-projecting L_p and M_p again reduces the integral in T_{DS} to an inner product of coefficient vectors. "*); "and defining an integral of a product of the function representing reflected light and

the function deriving the light source component" *(see first two paragraphs of section 4.1 defining T_{DU} and T_{DS}).*

34. **Claim 21** is met by the combination of Sloan et al, Neagle et al and Ewins, wherein Sloan et al discloses "the integral is equal to a dot product of respective coefficients of each of the functions" *(1st paragraph of section 4.1 as cited in the rejection of claim 20; 3rd paragraph of section 4.1 as cited in the rejection of claim 20; 2nd paragraph of section 6.2: "The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$.")*. In the first two paragraphs of section 4.1, Sloan et al shows the equation for the T_{DU} and T_{DS} integrals.

35. With regard to **claims 26-31**, Sloan et al does not use the explicit language " computer readable medium with program instructions "; however, one of ordinary skill in the art would recognize that this feature is inherent from the statement in the first paragraph of section 9: "For these models, multiplication with 25x25 or 9x25 transfer matrices over the surface in software forms the bottleneck." **Claims 26-31** are rejected with the rationale of claims 8, 9, 12, 13, 14, and 15 respectively. **Claims 26-31** recite claims 8, 9, 12, 13, 14, and 15 as a computer readable medium with program instructions.

36. **Claims 4-7 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sloan et al and Neagle et al in view of Ewins in view of P. Cignoni , C. Montani , R. Scopigno , C. Rocchini, "A General Method for Preserving Attribute Values on Simplified Meshes," October 1998, Proceedings of the conference on Visualization 1998, p. 59-66 (Cignoni et al.)**

37. With regard to **claim 4**, the combination of Sloan et al, Neagle et al and Ewins meets the limitations of parent claim 1; Sloan et al discloses the method operation of calculating a value representing a lighting characteristic for each of the texels includes, "and applying a basis function to determine the value" (*2nd paragraph of section 4: "In other words, each component of $(M_p)_i$ represents the linear influence that a lighting basis function $(L_p)_i$ has on shading at p."; 1st paragraph of section 6: "...compute incident lighting $\{L_{Pi}\}$ at one or more sample points P_i near O in terms of the SH basis..."*). Sloan et al does not explicitly disclose "defining an image associated with a first resolution" as in claim 4, and "the image on the display screen is associated with a second resolution, the second resolution being less than the first resolution" as in claims 6 or 11.

38. With regard to **claims 4, 6 and 11**, Cignoni et al teaches "defining an image associated with a first resolution," as in claim 4, and "the image on the display screen is associated with a second resolution, the second resolution being less than the first resolution" as in claims 6 and 11 (*5th paragraph of section 1: "It is performed by assuming that the simplified mesh S has a sufficiently similar shape if compared with the original high resolution mesh M...The retrieved attribute values are then stored in a texture map [10], which we later use to paint the pictorial detail of mesh M onto mesh S"*). Cignoni et al does not use the explicit language "display screen"; however, one of ordinary skill in the art would recognize that this feature is inherent from the statement in the third paragraph of section 5 "...converted into a 2D texture, and finally rendered with a standard OpenGL viewer. The Cignoni et al system would be inoperable if a display screen were not present.

39. With regard to **claims 4, 6 and 11,** at the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the method to simplify the mesh while preserving detail as taught by Cignoni et al in the method taught by Sloan et al. The motivation for doing so would have been to allows one to de-couple simplification from detail preservation as stated by Cignoni et al in the third paragraph of section 6, which would allow for a more efficient representation of the model. Therefore, it would have been obvious to combine Sloan et al with Cignoni et al to obtain the invention specified in **claims 4, 6 and 11.**

40. **Claim 5** is met by the combination of Sloan et al, Neagle et al, Ewins and Cignoni et al, wherein Sloan et al teaches "the value is represented by multiple coefficients" (*1st paragraph of section 4: "Incident lighting is therefore represented as a vector of n^2 coefficients $(L_p)_i$."*).

41. **Claim 7** is met by the combination of Sloan et al, Neagle et al, Ewins and Cignoni et al, wherein Sloan et al teaches "the method operation of applying a basis function to determine the value includes, executing a transfer function to yield the value" (*2nd paragraph of section 4.1: "We call the resulting factors the light function L_p, and the transfer function, M_p."; 1st paragraph of section 6: "...3. perform a linear transformation in $(L_p)_i$ at each point p on **O** to obtain exit radiance. This requires a dot product with $(M_p)_i$ for diffuse surfaces..."*).

42. **Claims 22-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sloan et al in view of U.S. Patent Application Publication No. 2002/0126133 to Ewins.**

43. With regard to **claim 22**, Sloan et al discloses "program instructions for calculating a value representing a lighting characteristic for each of the texels without calculating a lighting function at triangle corners" (*section 6: "For efficiency, we precompute textures for the basis functions... The resulting integral then becomes a simple dot product of the captured samples of*

$L_P(s)$ with the textures $B^m{}_l(s)$... "; 2^{nd} paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader. "); program instructions for accessing a lighting characteristic value associated with a texel of a texture map associated with the image (*5^{th} paragraph of section 6.2: "The basis function <u>textures</u> are also supersampled and decimated in the same way as a preprocess."*); and program instructions for applying the lighting characteristic value to a corresponding pixel for presentation on the display screen (*section 6: "For efficiency, we precompute textures for the basis functions... The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$... ";2^{nd} paragraph of section 6 "Our pixel shader needs 8 instructions to perform*

44. *the dot-product and stores LP's coefficients in constant registers."*). Sloan et al does not use the explicit language "computer readable medium with program instructions"; however, one of ordinary skill in the art would recognize that this feature is inherent from the statement in the first paragraph of section 9: "For these models, multiplication with 25x25 or 9x25 transfer matrices over the surface in software forms the bottleneck."

45. With regard to **claim 22**, Sloan et al discloses that the transfer vectors are computed for points over the surface of the object (*2^{nd} paragraph of section 4: "In other words, each component of $(M_p)_i$ represents the linear influences that a lighting basis function $(L_p)_i$ has on shading at p."*), stored in texture maps (*3^{rd} paragraph of section 6*) and used to compute exit radiance over the surface of the object (*1^{st} paragraph of section 6: "3. perform a linear transformation on $(L_p)_i$ at each point p on **O**..."*). However, Sloan et al does not expressly disclose the texels can have a many to one or one to many correspondence with pixels or a texture coordinate space is associated with display coordinate space. Ewins teaches "associating

a coordinate space of the texture map with a display screen coordinate space" and "generating a texture map associated with an image, the texture map defined by texels" (*paragraph [0014]: "Perspective-corrected texture mapping involves an algorithm that translates "texels" (data points from the bitmap texture image) into display pixels in accordance with the spatial orientation of the surface."*), "wherein each of the texels are capable of having a one of a one to many correspondence with respective pixels or a many to one correspondence with a single pixel" (*paragraph [0017]: "This conception is useful in analyzing the mapping between a texture map and image space. One pixel in the image space can fall across many texels in the stored texture map, or one texel may cover many pixels."*).

46. With regard to **claim 22**, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the pixel, texel and geometry correspondence taught by Ewins to the system and method disclosed by Sloan et al. The suggestion and motivation for doing so would have been create a perspective correct image. Therefore, it would have been obvious to modify Sloan et al with the teachings of Ewins to obtain the invention specified in **claim 22**.

47. With regard to **claim 23**, Sloan et al shows the limitations of claim 22 on which claim 23 depends. Sloan is silent on "mapping the coordinate space of the texture map with the display screen coordinate space." Official Notice is taken that the concept and the advantage of "mapping a coordinate space of the texture map with a display screen coordinate space, rendering the image on a display screen and displaying pixels" are well known and expected in the art. It would have been obvious to have included these operations in Sloan et al as "mapping

a coordinate space of the texture map with a display screen coordinate space" are known operations to provide visual feedback in computer graphics.

48. With regard to **claim 24**, Sloan et al shows the limitations of claim 22 on which claim 24 depends. Sloan et al teaches "the program instructions for applying the lighting characteristic value to a corresponding pixel for presentation on the display screen includes, program instructions for multiplying coefficients of the lighting characteristic with coefficients representing incoming light" (*1st paragraph of section 4.1: "By SH-projecting L_p and H_{Np} separately, equation (5) reduces T_{DU} to an inner product of their coefficient vectors."; 3rd paragraph of section 4.1: "Separately SH-projecting L_p and M_p again reduces the integral in T_{DS} to an inner product of coefficient vectors."*).

49. With regard to **claim 25**, Sloan et al teaches "the lighting characteristic is derived from a spherical harmonics based function" *(1st paragraph of section 3: "Spherical harmonics define an orthonormal basis over the sphere, S..."; 2nd paragraph of section 3: "Because the SH basis is orthonormal, a scalar function f defined over S can be projected into its coefficients via the integral."; 1st paragraph of section 4.1: "By SH-projecting L_p and H_{Np} separately, equation (5) reduces T_{DU} to an inner product of their coefficient vectors."*).

50. **Claims 32, 34 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sloan et al in view of U.S. Patent No. 6,639,595 to Drebin et al.**

51. With regard to **claim 32**, Sloan et al teaches a computing device (*1st paragraph of section 9: "Timings are on a 2.2 GHz Pentium 4 with ATI Radeon 8500 graphics card."*) comprising:

e. "a texel associated with data describing a light field for a point within the texel according to a basis function" (*2nd paragraph of section 4: "In other words, each*

component of $(M_p)_i$ represents the linear influence that a lighting basis function $(L_p)_i$ has on shading at p."; 1st paragraph of section 6: "...compute incident lighting $\{L_{Pi}\}$ at one or more sample points P_i near O in terms of the SH basis..."; as previously shown $(M_p)_i$ is a transfer vector stored in a texture map containing texels);

f. "logic for determining an intensity associated with the pixel based upon the data describing the light field" (*2nd paragraph of section 6.2: "The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$"; Figure 2 shows an overview of this process*).

52. Sloan et al does not use the explicit language "logic for accessing the data describing the light field" or "logic" as recited above; however, one of ordinary skill in the art would recognize that "logic" is the form of a software program that implements the method taught, which is shown by the statement in the first paragraph of section 9: "For these models, multiplication with 25x25 or 9x25 transfer matrices over the surface in software forms the bottleneck." The transfer matrices are data describing the light fields, as shown in second paragraph of section 4 previously cited.

53. Sloan et al is silent on "a memory capable of storing data representing a texture map associated with an object of image, the texture map containing a texel, logic for mapping the texel to a pixel associated with a display screen in communication with the computing device, logic for enabling presentation of the intensity of the pixel on the display screen."

54. Drebin et al discloses "a memory capable of storing data representing a texture map associated with an image, the texture map containing a texel " (*lines 29-33 of column 8: "Texture unit 500 (which may include an on-chip texture memory (TMEM) 502) performs various tasks*

related to texturing including for example: retrieving textures 504 from main memory 112..."); "logic for mapping the texel to a pixel associated with a display screen in communication with the computing device" (*lines 14-17 of column 8: "Transform unit 300 transforms incoming geometry per vertex from object space to screen space; and transforms incoming texture coordinates and computes projective texture coordinates (300c)."; Fig 2 and Fig 5 show the texture unit is in communication with the computing device*); and "logic for enabling presentation of the intensity of the pixel on the display screen" (*lines 25-29 of column 8: "Setup/rasterizer 400 includes a setup unit which receives vertex data from transform unit 300 and sends triangle setup information to one or more rasterizer units (400b) performing edge rasterization, texture coordinate rasterization and color rasterization."*).

55. With regard to **claim 32,** at the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the graphics system disclosed by Drebin et al to perform the method disclosed by Sloan et al. The motivation for doing so would have been to provide an interface for a user to interact with the three-dimensional graphics created by the Sloan et al system as stated by Drebin et al in lines 58-60 of column 4: "System 50 can be used to play interactive 3D video games with interesting stereo sound." Therefore, it would have been obvious to combine Sloan et al with Drebin et al to obtain the invention specified in **claim 32.**

56. **Claim 34** is met by the combination of Sloan et al and Drebin et al, wherein Drebin et al discloses "a display screen in communication with the computing device" (*5-8 lines of column 5: " To play a video game or other application using system 50, the user first connects a main unit 54 to his or her color television set 56 or other display device by connecting a cable 58 between*

the two."; 9-10 lines of column 5: " The video signals are what controls the images displayed on the television screen 59... ").

57. **Claim 35** is met by the combination of Sloan et al and Drebin et al, wherein Sloan et al discloses the logic for determining an intensity associated with the pixel based upon the data describing the light field includes, logic for determining an incoming illumination value without calculating a lighting function at triangle corners" (*1st paragraph of section 6: "...compute incident lighting {L_{Pi}} at one or more sample points P_i near O in terms of the SH basis... "; ; section 6: "For efficiency, we precompute textures for the basis functions... The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$... "; 2nd paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader. "*); "and logic for combining the incoming illumination value with the data describing the light field" (*2nd paragraph of section 4: "In other words, each component of $(M_p)_i$ represents the linear influence that a lighting basis function $(L_p)_i$ has on shading at p. "; equations for computing $(M_p)_i$ are given in 6th and 7th paragraphs of section 5*).

58. **Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sloan et al in view of Drebin et al and in further view of U.S. Patent 6,672,964 to Kobayashi.**

59. With regard to claim 33, the combination of Sloan et al and Drebin et al shows a video game console, wherein Drebin et al discloses "the computing device is one of a video game console and a server" (*lines 58-60 of column 4: "System 50 can be used to play interactive 3D video games with interesting stereo sound. "*), as well as the limitations of the parent claim 32. The combination of Sloan et al and Drebin et al does not disclose a server. Kobayashi discloses a

server (*lines 55-58 of column 7: "The communications interface 19 is connected to a network 110, and acquires various kinds of data by performing data communications with data storage devices and information processing devices such as servers installed in other locations."; Figure 1*).

60. Sloan et al, Drebin et al and Kobayashi et al are analogous art because they are from the same field of endeavor/similar problem solving area: real-time rendering. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate a server as disclosed by Kobayashi et al into the Sloan et al and Drebin et al combination. The motivation for doing so would have been allow the data to be stored at a remote location as described by Kobayashi et al in lines 55-58 of column 7, which would be advantageous for multi-player video games as described by Kobayashi et al in various aspects of the invention (*for example, lines 15-18 of column 2: "first aspect of the invention provides a computer-readable recording medium on which is recorded a video game program capable of displaying multiple characters including a player character..."*), because the players do not have to be at a specific physical location to participate in the same game. Therefore, it would have been obvious to combine Sloan et al and Drebin with Kobayashi et al to obtain the invention specified in claim 33.

61. **Claims 36-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sloan et al in view of U.S. Patent No. 6,639,595 to Drebin et al in view of U.S. Patent Application Publication No. 2002/0126133 to Ewins.**

62. With regard to **claim 36,** Sloan et al discloses the illumination value is "derived without calculating a lighting function at triangle corners" (*section 6: "For efficiency, we precompute*

textures for the basis functions... The resulting integral then becomes a simple dot product of the captured samples of $L_P(s)$ with the textures $B^m{}_l(s)$... "; 2^{nd} paragraph of section 6: "The transfer vectors can also be stored in texture maps rather than per-vertex and evaluated using a pixel shader."). The remaining limitations of claim 36 are similar in scope to claim 32, and are rejected with the rationale of claim 32; claim 36 recites the limitations of claim 32 as an integrated circuit. Drebin et al discloses an integrated circuit (*lines 52-54 of column 6: "FIG. 3 is a block diagram of an example graphics and audio processor 114. Graphics and audio processor 114 in one example may be a single-chip ASIC (application specific integrated circuit)."*). In Fig. 4, Drebin et al shows the graphics and audio processor 114 comprises the 3D graphics pipeline, which comprises texture unit 500, transform unit 300, and Setup/rasterizer 400.

63. With regard to **claim 36,** Sloan et al and Drebin et al are analogous art because they are from the same field of endeavor: real-time rendering. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the graphics system disclosed by Drebin et al to perform the method disclosed by Sloan et al. The motivation for doing so would have been to provide an interface for a user to interact with the three-dimensional graphics created by the Sloan et al system as stated by Drebin et al in lines 58-60 of column 4: "System 50 can be used to play interactive 3D video games with interesting stereo sound." Therefore, it would have been obvious to combine Sloan et al with Drebin et al to obtain the invention specified in **claim 36.**

64. With regard to **claim 36**, Sloan et al does not expressly disclose the texels can have a many to one or one to many correspondence with pixels. Ewins teaches "generating a texture

map associated with an image, the texture map defined by texels wherein each of the texels are capable of having a one of a one to many correspondence with respective pixels or a many to one correspondence with a single pixel" as shown in the rejection of claim 32. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate the pixel, texel, and geometry correspondence taught by Ewin to the system and method disclosed by Sloan et al and Drebin et al. The suggestion and motivation for doing so would have been create a perspective correct image. Therefore, it would have been obvious to further modify the combination of Sloan et al with Drebin et al with the teachings of Ewin to obtain the invention specified in **claim 36**.

65. **Claims 37 and 38** are met by the combination of Sloan et al, Drebin et al and Ewins, wherein Drebin et al discloses "the image is associated with a video game" and "the integrated circuit is incorporated into a video game console" (*lines 54-57 of column 4: " FIG. 1 shows an example interactive 3D computer graphics system 50. System 50 can be used to play interactive 3D video games with interesting stereo sound."; Fig. 2 shows the graphics processor 114 incorporated into system 50*).

66. **Claim 39** is met by the combination of Sloan et al, Drebin et al and Ewins, wherein Drebin et al discloses "the data is associated with a texel of a texture map stored in memory" (*lines 29-33 of column 8: "Texture unit 500 (which may include an on-chip texture memory (TMEM) 502) performs various tasks related to texturing including for example: retrieving textures 504 from main memory 112..."*).

67. **Claim 40** is met by the combination of Sloan et al, Drebin et al and Ewins, wherein Drebin et al discloses "wherein a lookup table maps the texel to the pixel" (*lines 16-20 of column*

10: "While texture function 306 may be implemented in a variety of different ways, a cost-effective approach is to store the texture function 306 output values in a texture lookup table or map and to access those values using texture coordinates.").

Response to Arguments

68. Applicant's arguments filed 4/7/2006 have been fully considered but they are not persuasive.

69. With regard to the argument "Neagle cannot teach sampling a pixel at a center point because this is meaningless when referring to pixels," this assertion is incorrect in the context of super-sampling as disclosed in the Neagle et al reference. The Applicant's assertion "there is no center to a single pixel" contradicts the Neagle et al reference (*paragraph 129: "Each pixel has exactly one data point calculated for it, and the single data point is <u>located at the center of the pixel.</u>"; paragraph 131: "Filter 72 may simply average samples 74A-B to form the final value of output pixel 70, or it may increase the contribution of sample 74B (<u>at the center of pixel 70</u>) and diminish the contribution of sample 74A (i.e., the sample farther away from the center of pixel 70)."*). Applicant's attention is directed to FIG. 4, FIG. 5A, and FIG. 5B of the Neagle et al reference and the accompanying detailed description. In the description of the use of multiple-samples in paragraph 131, Neagle et al explicitly states sample 74B is "at the center of pixel 70." Furthermore, Neagle et al defines a sample position (*paragraph 113: "Stated another way, the sample buffer stores a plurality of samples that have positions that correspond <u>to locations in screen space on the display</u>, i.e., the samples contribute to one or more output pixels on the display."*), and sample position information relative to a pixel center coordinate (*paragraph 119: "The sample position information may also comprise offset values, wherein the offset values are*

relative to pre-defined locations in the sample buffer, such as...pixel center coordinates."). In the embodiment disclosed in paragraph 256, Neagle et al restricts one of the sample locations to the center location: "In one embodiment, the graphics system ensures that one of the rendered samples lies in the center of the bin or pixel area." Therefore, the Neagle et al reference teaches "sampling at the center of a pixel," which was relied upon in the rejections in the Office Action dated 2/7/2006. The sampling method disclosed by Neagle et al can be applied to sampling the texture used by Sloan et al in paragraph 5 of section 6.2 ("Sampling SH Radiance on Graphics Hardware"): "To reduce aliasing...The basis function textures are also super-sampled and decimated in the same way as a preprocess." In paragraph 15, Neagle et al states the advantages of performing super-sampling that are well known in the art:

> *To obtain more realistic images, some prior art graphics systems have gone further by generating more than one sample per pixel...By calculating more samples than pixels (i.e., super-sampling), a more detailed image is calculated than can be displayed on the display device. For example, a graphics system may calculate four samples for each pixel to be output to the display device. After the samples are calculated, they are then combined or filtered to form the pixels that are stored in the frame buffer and then conveyed to the display device.*

Conclusion

70. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Jonathan Cohen, Marc Olano, Dinesh Manocha, "Appearance-Preserving Simplification," July 1998, Proceedings of the 25th Annual Conference on Computer Graphics and Interactive Techniques, p. 115-122 teaches texture mapping simplified meshes.

71. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M. Repko whose telephone number is 571-272-8624. The examiner can normally be reached on Monday through Friday 8:30 am -5:00 pm.

72. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on 571-272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

73. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JMR

Ulka Chauhan

ULKA CHAUHAN
SUPERVISORY PATENT EXAMINER